Claims

1. A method for reducing shrinkage during sintering low-temperature-cofired ceramics, the ceramics comprising a dielectric portion and a heterogeneous material portion, the method comprising the steps of:

(a) providing a monolithic structure, the monolithic structure comprising:

a dielectric body comprising at least one dielectric layer that comprises at least one active area; wherein said active area is disposed with at least one heterogeneous material pattern, and said heterogeneous material pattern comprises at least one heterogeneous material component and/or module; and

a constraining layer positioned on the top of the dielectric body, the constraining layer comprising at least one window and wherein the edge of the active area of the dielectric layer each falls within the window in vertical direction;

(b) firing the monolithic structure; and

(c) singulating the monolithic structure along a cutting line to provide the low-temperature-cofired ceramics, wherein the cutting line is disposed in the area formed between the edge of the window and the edge of the active area.

2. The method according to Claim 1, wherein the edges of a plurality of the active areas as a whole each fall within the windows.

3. The method according to Claim 1, wherein the dielectric body comprises at least two of the dielectric layers, and the edge of the active

area of any of the dielectric layer each falls within the window of the constraining layer position on the top of the dielectric body in vertical direction.

4. The method according to Claim 3, wherein the dielectric body further comprises a constraining layer positioned between the dielectric layers of the dielectric body, the constraining layer comprising at least one window, and the edge of the active area of the dielectric layer each falls within the window of the constraining layer in vertical direction.

5. The method according to Claim 4, wherein the thickness of the constraining layer (L_1) applied between the dielectric layers of the dielectric body is not thinner than the thickness of the heterogeneous material pattern (L_2) disposed on the dielectriclayer positioned adjacent and below the constraining layer.

6. The method according to Claim 5, wherein $L_1 = L_2$.

7. The method according to Claim 1, wherein the monolithic structure further comprises a constraining layer positioned on the bottom the dielectric body.

8. The method according to Claim 7, wherein the constraining layer comprises at least one window, and the edge of the active area of the dielectric layer each falls within the window of the constraining layer in vertical direction.

9. The method according to Claim 7, wherein a ratio (L_4/L_3) of the total thickness of the dielectric body (L_4) and the thickness of the constraining layer (L_3) positioned on the top or bottom of the dielectric body is less than about 3.5.

10. The method according to Claim 4, wherein a ratio (L_4/L_3) of the total thickness of the dielectric body (L_4) and the thickness of the

constraining layer (L_3) positioned on the top or bottom of the dielectric body is less than about 3.5.

11. The method according to Claim 1, wherein the monolithic structure further comprises

a cover layer positioned on the constraining layer; and

a constraining layer positioned on the cover layer.

12. The method according to Claim 1, wherein the monolithic structure further comprises

a cover layer positioned on the bottom of the dielectric body; and

a constraining layer positioned below the cover layer.

13. The method according to Claim 1, wherein the monolithic structure further comprises a constraining layer (disposed on the top of the dielectric body) - m dielectric layers and n constraining layers alternated in the dielectric body - a constraining layer (disposed on the bottom of the dielectric body), wherein m is greater than n.

14. The method according to Claim 1, wherein the monolithic structure further comprises a constraining layer – a cover layer - a constraining layer (disposed on the top of the dielectric body) - m dielectric layers and n constraining layers alternated in the dielectric body - a constraining layer (disposed on the bottom of the dielectric body) – a cover layer – a constraining layer, wherein m is greater than n.

15. The method according to Claim 14, wherein m is equal to n + 1.

16. The method according to Claim 1, wherein the shortest length of the constraining layer is L; the radius of a circumscribed circle of each window is c; the distance between the adjacent circumscribed circles is a; the distance between the outermost window and the edge of the constraining layer is b, $c<0.5L$, $a>0.1c$, $b>0.1c$.

17. The method according to Claim 1, wherein the constraining layer positioned on the top of the dielectric body is a high sintering temperature constraining layer with a sintering temperature higher than that of the dielectriclayer.

18. The method according to Claim 17, wherein the high sintering temperature constraining layer comprises Al_2O_3.

19. The method according to Claim 1, wherein the constraining layer is a low sintering temperature constraining layer with a sintering temperature lower than that of the dielectric layer.

20. The method according to Claim 19, wherein the low sintering temperature constraining layer comprises about 1 % to about 10 % of a strong auxiliary component to lower the sintering temperature of the constraining layer.

21. The method according to Claim 20, wherein the strong auxiliary component is vanadium oxide.

22. The method according to Claim 1, wherein a Z-direction of pressure is applied during firing.

23. The method according to Claim 1, wherein bonding glass is applied between the dielectric body and the constraining layer positioned on the top of the dielectric body.

24. The method according to Claim 23, wherein the bonding glass comprises borosilicate glass.

25. The method according to Claim 1, wherein at least one of the dielectric layers and the constraining layer positioned on the top of the dielectric body comprise bonding glass.

26. The method according to Claim 25, wherein the constraining layer comprises about 1 % to about 10 % of bonding glass.

27. The method according to Claim 26, wherein the constraining layer comprises about 1 % to about 6 % of bonding glass.

28. The method according to Claim 1, wherein singulating the monolithic structure in step (c) is selected from sawing, cutting, laser cutting, or dicing.

29. The method according to Claim 1, which further comprises the step (d) singulating the monolithic structure along the edge of the active area of the dielectric layer.